Staphylococcus aureus MRSA

Infectious Disease Epidemiology Section
Office of Public Health
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...Your Taxes at Work...

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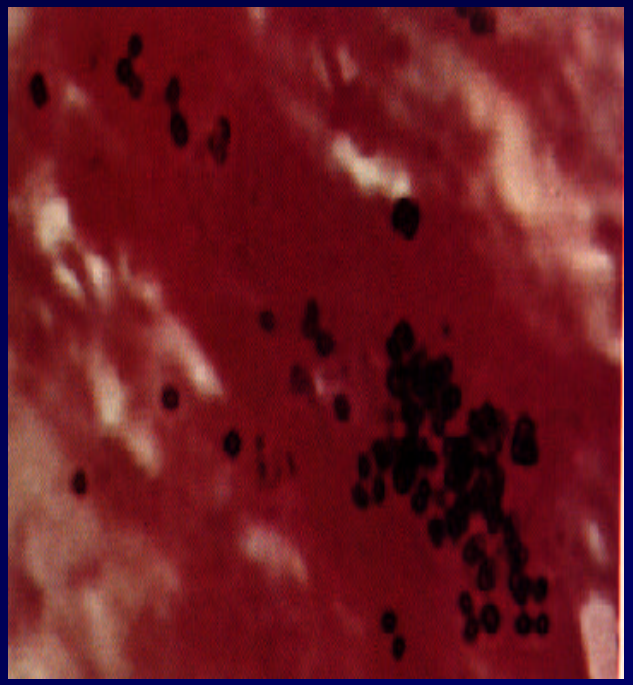
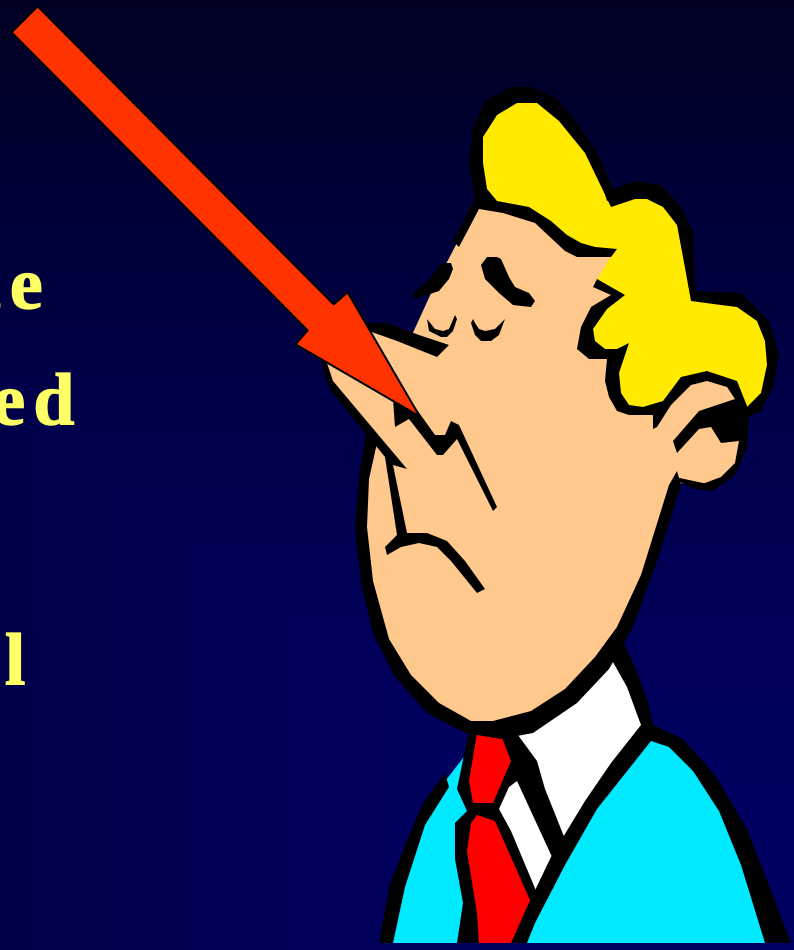
S.aureus Colonization

- About 30% of people are COLONIZED
- Average 2.8 strains /person
- Colonization more frequent in
  - Newborns
  - Hemodialysis patients
  - People with dermatitis, eczema
  - Diabetics
- HALF LIFE: 40 months

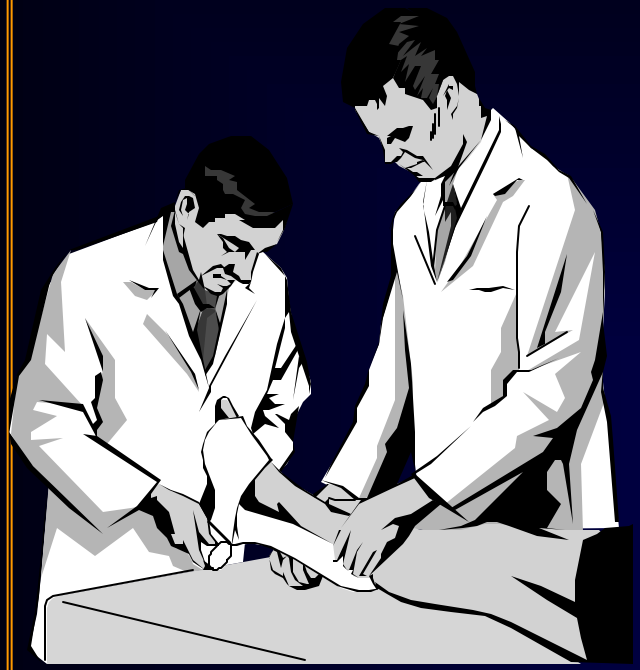


Sites of Colonization

- **NASAL AREA**
- **WOUND**
- **Tracheostomy site**
- **Sputum (intubated patient)**
- **Armpit, groin, Perineum, perianal area, rectum**



Mode of Transmission



- From person to person by colonized hands
- RARELY from environment
- In BURN, HYDROTHERAPY units environment is of concern
- Sometimes by droplets in tracheostomy patients

Staphylococcus aureus Antibiotic Sensitivity (Global)

- **Most (95%) have acquired b lactamase (Plasmid) :**
  - **Methicillin, nafcillin, oxacillin resistant to b lactamase**
  - **Cephalothin most resistant, Cefazolin more sensitive**
- **Intrinsic resistance with modified PBP (Chrom): MRSA**
- **Variable resistance to other AB: Clindamycin, Erythromycin, …**
- **Rifampin very active on SA but rapid ⇧R**
- **Resistance to fluoroquinolones develop rapidly**
- **No full resistance to Vancomycin**

MRSA

METHICILLIN
RESISTANT
STAPHYLOCOCCUS
AUREUS

Why is MRSA a major concern ?

- Appeared in 1960s
- Slowly increase in frequency first in hospitals,
- Now moving out to the community
- 1999: % MRSA /SA in hospital acquired infections in USA = 50%
- Potential for large hospital outbreaks Treatment is difficult & expensive

Why MRSA is NOT a superbug ?

- Many strains cause SPORADIC cases
- Only some strains (EMRSA) cause EPIDEMICS
- Most MRSA are simple COLONIZERS
- MRSA are **NOT** more virulent than other SA: NO difference in
  - in animal lethality,
  - in production of enzymes
  - in production of toxins associated with invasiveness

MRSA More Prevalent among in-Patients

Source	% (MRSA Strains/All SA)	
	Colonization	Infection
IN Patients	13.3%	4.9%
OUT Patients	2.0%	1.6%

13% of SA from colonization sites are MRSA

NOT 13% of patients are colonized with MRSA

MRSA Moved into the Community

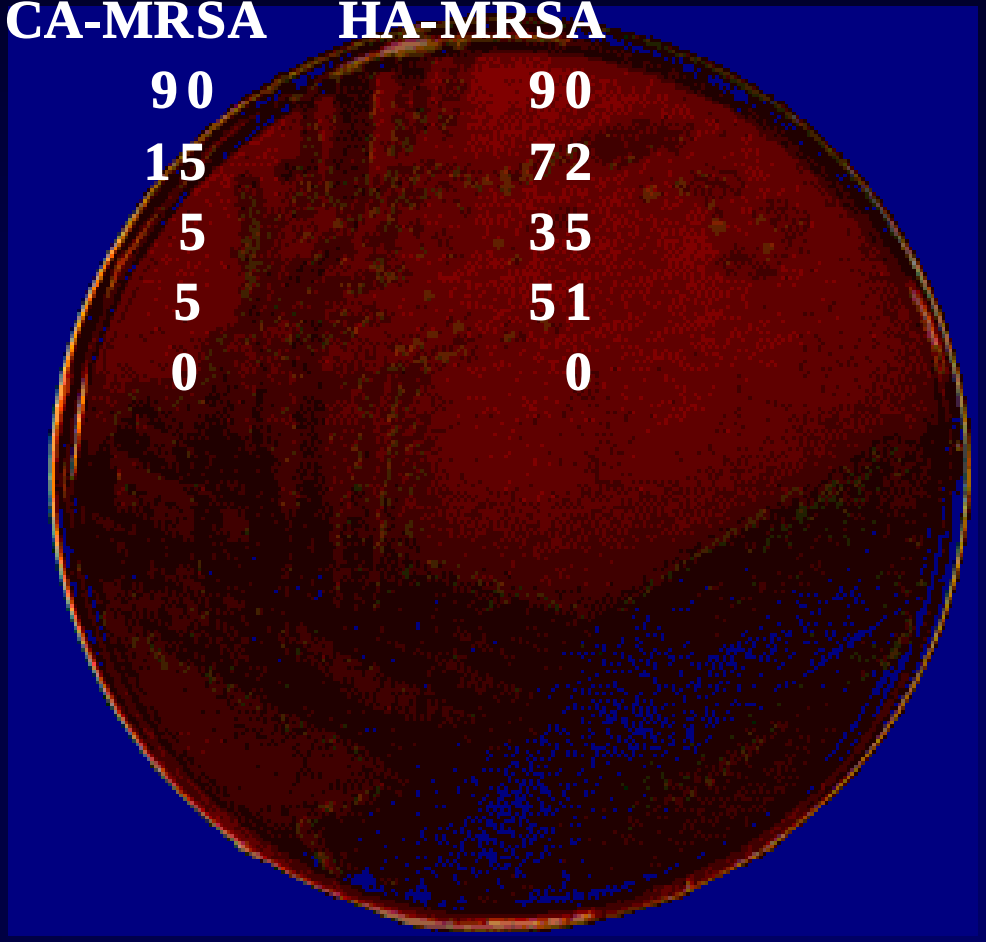
- About 40% of adult cases community acquired (Chambers HF, Emerg Inf Dis 2001, 7:178-182).
- Community acquired MRSA infections common in:
  - patients with cystic fibrosis,
  - day-care centers,
  - wrestling teams,
  - prisons

HA-MRSA / CA-MRSA

- **CA-MRSA strains may be more virulent**
  - **1999: 4 cases of lethal MRSA infections among children (MN, ND)**
  - **hepatic abscess, brain abscess and necrotizing pneumonia**
  - **superantigens (SEB and SEC, but not TSST-1)**
- **CA-MRSA typically resistant to methicillin and cephalosporins (blactams) but NOT to many other antibiotics in contrast to HA-MRSA = multisensitive MRSA**
- **CA-MRSA = community strain that acquired just 1 resistance gene and retains attributes of wild strain**

HA-MRSA is Multiresistant
CA-MRSA is Multisensitive

Antibiotic	% Resistant Strains		
	SA	CA-MRSA	HA-MRSA
Cephalothin	1	90	90
Erythromycin	5	15	72
Clindamycin	2	5	35
Ciprofloxacine	2	5	51
Vancomycin	0	0	0



Treatment of MSSA

Drugs of choice: Nafcillin or oxacillin

Alternatives:

- **Cefazolin**
- **Vancomycin**
- **Ampicillin + sulbactam**
- **Amoxicillin + clavulanate**
- **Clindamycin**
- **Imipenem**
- **Meropenem**

Treatment of MRSA

Drugs of choice: Vancomycin, gentamicin, rifampin

Alternatives:

Susceptibility testing should be done before alternative

- **TMP-SMX**
- **Minocycline** Not for pregnant women or children < 8
- **Fluoroquinolones** Not < 18 years of age
- **Clindamycin**
- **Quinupristin-dalfopristin**

Initial empiric therapy until susceptibility pattern available (organism of unknown susceptibility)

Drugs of choice:

- **For life–threatening infections (ie, septicemia, endocarditis, pneumonia, meningitis); : Nafcillin or oxacillin + vancomycin +gentamicin**

  some experts would not add nafcillin or oxacillin

- **For non–life-threatening infection, without signs of sepsis (eg, osteomyelitis, pyarthrosis, skin infection, cellulitis) Nafcillin or oxacillin**

- **Community–acquired infection in children when rate of MRSA in community is low**
  - **Nafcillin or oxacillin + clindamycin**

- **Community–acquired infections in communities with increased rate of MRSA colonization and infections**
  - **Vancomycin + nafcillin**

- **Hospital–acquired infections, not life-threatening**
  - **Vancomycin + quinupristin-dalfopristin**
- **For life–threatening infection in patient who has received several recent courses of vancomycin**

Redbook 2000

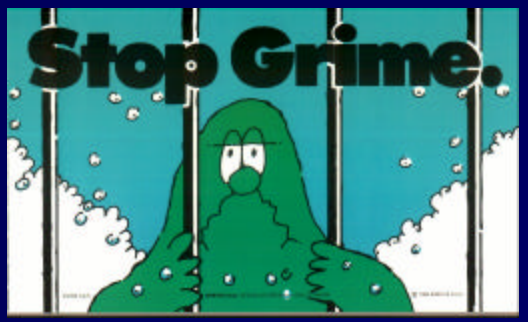
Hospital Acquired MRSA

Epidemiologic Surveillance

- Laboratory surveillance
- Surveillance of nosocomial infections
- List of MRSA cases
- Search for linkages & outbreaks
- Goal is to have early warning system if epidemic strain imported

Standard Precautions

- Promotion of **HANDWASHING** as the main infection control measure
- Barrier precaution required by **Standard Precautions** when touching blood and body fluids



Contact Precautions for known MRSA cases

- **Use of antimicrobial soap for personnel and patient bathing when MRSA contact is involved**
- **Contact isolation for known cases of MRSA**
  - **Strict handwashing**
  - **Gloves for direct contact with infected tissues**
  - **Aprons or gowns for patient care**
  - **Mask if coming within 1m of patients sputum +**
- **Patient placement in private rooms whenever possible.**
- **No placement of MRSA patients with other high risk patient in same room**
- **Strict isolation** *There is little convincing evidence that MRSA is transmitted either by the airborne route or from the environment…therefore* ***strict isolation is not warranted*** (AHA 1994).

Discontinuing isolation
(Longterm resident or special indications)

- Patient off all antibiotics for 72 hours
- Screen weekly (q2 days if in a hurry): nose, perineum, skin lesions, tracheostomy, & positive sites
- 3 negative screening to consider patient cleared.

Management of known MRSA cases

- TAG cases so that contact precautions are taken in future hospitalizations
- Determine extent of colonization: Nose, throat, perineum, wounds, skin lesions, urine if catheterized, tracheostomy site
- Chlorhexidine bath (qd or q3days), change bedding
- Cover lesions, strict aseptic techniques
- Treat infection, do NOT treat colonization for short term patient
- Eradicate colonization for long term residents only (not always easy)
- Discharge ASAP

Management of known MRSA cases
Transfer

- Transfer to other Units. Bathe and wash hair with an antiseptic before transfer
- Notify receiving area
- Staff transporting patient consider gloves, gowns
- Schedule at end of working session,
- Minimum time in area.
- If MRSA in sputum: patient must wear a mask
- If surgery:
  - Clear MRSA prior to surgery.
  - Cover lesions with impermeable dressing during surgery
  - Treat adjacent areas with 70% ethanol.

Systematic screening is a Fishing Expedition

- SA may not be present in nose at the time of swab
- SA may be in the nose, but be missed by the swab
- SA may be collected by the swab but fail to grow on plate
- SA may be growing on the plate but not be selected for test
- SA may be tested but sensitivity test was not adequate

Finding MRSA is a fishing expedition

NO systematic screening

- ***Culture surveys are not indicated as a routine infection control measure*** (AHA 1994). The AHA accepts prevalence culture surveys in hospital where MRSA is endemic (20-30%) of patients colonized or infected and during outbreak investigation

- ***Screening of persons at high risk of having MRSA at the time of admission will detect some MRSA carriers who can then be placed under special precautions. This costly practice is not likely to be helpful unless MRSA colonization is relatively common among patients referred for admission from other facilities. This measure is not warranted in most facilities.*** (AHA 1994).

Methods for Detection of Carriers (if Necessary)

- Rotate unmoistened nylon swab 5 times around anterior portion of nares with gentle pressure on nares
- Roll swab onto plates of selective media (Mannitol salt agar
- Incubate at 30-35^{o}C for >48hrs
- MRSA carriers: 30,000 Colony Forming Units /swab

Eradication of MRSA carriage is NOT recommended routinely

- Difficulty in achieving long term eradication,
  Most antibiotics do not reach
  sufficient concentration in nasal secretions
- No obvious endpoint
- Relapses
- Promotion of resistance: frequent with quinolones and rifampin, catatrosphic with vancomycin
- Complications due to side effects
- High cost of monitoring long term results

NO eradication of colonization

- ***Because colonized or infected patients or residents represent the major reservoir of MRSA, eradicating the organisms from all such patients theoretically should reduce the reservoir of MRSA in an intitution. This approach has been used…widespread use of antimicrobial agents for decolonization therapy has resulted in emergence of resistance to the agents used….this measure should be considered for use only during hospital outbreaks or when MRSA is highly endemic and should not be the major component of the control program*** **(AHA 1994).**
- ***Decolonization therapy for patients requiring transfer to a nursing facility…this practice is not recommended*** **(AHA 1994).**
- **Systematic cultures associated with decolonization therapy are often combined into the *"seek and destroy mentality"*. It does not work.**

Eradication of Nasal Carriage
(Special indications)

Susceptibility testing necessary before treatment

Topical	Mupirocin	2% ointment	tid	3 days
	Vancomycin	5%	tid	14-28 days
	Bacitracin	(with syst)	tid	5 days
	Fusidic acid	4%	tid	14 days
Oral	Rifampin	600 mg	qd	5 days
	Trimethoprim Sulfa	160/800 mg	bid	5 days
	Minocycline	100mg	bid	14 days
	Ciprofloxacine	750mg	bid	14 days

Eradication of colonization
(Longterm resident or special indications)

Nose: mupirocin (Bactroban Nasal) into anterior nose.
If mupirocin-resistant, use 1% chlorhexidine and Naseptin Cream.

Other Sites:

- **Antiseptic detergent (chlorhexidine, povidone-iodine, Triclosan) for skin and hair**
- **Mupirocin (Bactroban) to treat lesions (eczema, pressure sores)**
- **Hexachlorophene powder (0.33% Sterzac powder) on axillae and groins if colonized. Do not use on broken areas of skin. Use cautiously in infants.**
- **In cases of throat or sputum colonization, topical nasal applications ineffective.**
- **Urine: remove the catheter, if possible. If not, change half way through Rx.**

Treatment of Infection

- **IV VANCOMYCIN is treatment of choice**
- **lactams are not recommended even if active in vitro**
- **If antibiotic resistance testing show sensitivity, consider combinations of:**
  - **Rifampin (okay with vancomycin, potential for *in vivo* antagonism)**
  - **Gentamicin (synergy with vanco-mycin)**
  - **Novobiocin**
  - **Trimethoprim sulfmethoxazole**
  - **Ciprofloxacin**
  - **Minocycline (synergy with rifampin)**
  - **Fusidic acid (not in US), with rifampin, novobiocin, aminoglycoside, vancomycin**

Outbreak Situation

- Carry out epidemiologic investigation:
- Identify extent of patient colonization
- Identify staff colonized
- Establish links between patients /patient-staff.
- Evaluate relative importance of modes of transmission
  - transient hand contamination
  - common source carriers
  - common source vehicle
- Select appropriate interventions to address epidemiologic situation
- Isolation and cohorting
- Eradication of colonization among patients and staff

Community Acquired MRSA

Frequency of CA-MRSA

- **Prevalence of CA-MRSA infection:**
  - **estimated at 208/100,000 in Chicago**
  - **(Hussain FM, Pediatr Inf Dis J 2000, 19:1163-1166)**
- **Prevalence 10/100,000 in 1988/90**
  ↑ 259/100,000 in 1993/95.

Outbreak of CA-MRSA

- **MS prison (11/98 to 10/99):**
  - **3000 inmates, 45 cases MRSA infections /1 year**
  - **Skin abscesses, furuncles, open wounds most common**
  - **Only 2 cellulitis and 2 systemic infections**
  - **Prisoners change dressings, lanced boils with tweezers or fingernails, shared personal items (linen, pillows, clothings)**
  - **Among 1,800 inmates screened, 5% MRSA carriage,**
    - **5.4% for those incarcerated for over 60 days**
    - **1% for those recently incarcerated**

Prevention of CA-MRSA

- **Community-acquired S aureus infections in immunocompetent hosts cannot be prevented because the organism is ubiquitous and there is no vaccine (Redbook 2000)**

- **Promote good hygienic standards**
  - **Handwashing, plain soap OK**
  - **Showers**
  - **Do not pick, press, touch wounds, boils and other skin infections**

Patient Management

- Culture severe skin diseases, treatment failures of presumed S.aureus skin infections
- Base treatment on antimicrobial sensitivity, use older antibiotics if effective
- maintaining cleanliness of skin abrasions may prevent hematogenous spread.
- For patients with disorders of neutrophil function or with chronic skin conditions, who are predisposed to S aureus infections,
  - scrupulous attention to skin hygiene,
  - minimize sweating by using proper clothing and bed linen
  - eradication of nasal carriage, if present
  - early use of antibiotics,
  - prolonged use of trimethoprim-sulfamethoxazole

CDC

Colonized People

- **No need to screen: 2-5% are carriers**
  so many carriers, so little time, so little resources
- **No need to treat carriers**

HANDWASHING will stop MRSA in its tracks

STOP MRSA